ABUNDANCE AND PRODUCTIVITY ESTIMATES
ATLANTIC COAST PIPING PLOVER POPULATION, 1986-2008

Abundance

Population monitoring on the breeding grounds has been an integral part of the recovery program for Atlantic Coast Piping Plovers since 1986, and annual coastwide censuses have tracked local and regional progress toward recovery. Abundance of Atlantic Coast piping plovers is reported as numbers of breeding pairs, i.e. adult pairs that exhibited sustained ($\geq$ 2 weeks) territorial or courtship behavior at a site or were observed with nests or unfledged chicks (USFWS 1996). Annual estimates of breeding pairs of Atlantic Coast piping plovers are based on multiple surveys at most occupied sites, as well as many unoccupied sites. Sites that cannot be monitored repeatedly in May and June (primarily sites with few pairs or inconsistent occupancy) are surveyed at least once during a standard nine-day count period (Hecht and Melvin 2009).

Since its 1986 listing, the Atlantic Coast piping plover population estimate increased 234%, from approximately 790 pairs to an estimated 1,849 pairs in 2008, and the U.S. portion of the population has almost tripled, from approximately 550 pairs to an estimated 1,596 pairs (Table 1). Even discounting apparent increases in New York, New Jersey, and North Carolina between 1986 and 1989, which likely were due in part to increased census effort (USFWS 1996), the population nearly doubled between 1989 and 2008. The largest population increase between 1989 and 2008 has occurred in New England (245%), followed by New York-New Jersey (74%). In the Southern recovery unit, overall growth between 1989 and 2008 was 66%, but almost three-quarters of this increase occurred in two years, 2003-2005. The eastern Canada population fluctuated from year to year, with increases often quickly eroded in subsequent years; net growth between 1989 and 2008 was 9%.

The overall population growth pattern was tempered by periodic rapid declines in the Southern and Eastern Canada recovery units. The eastern Canada population decreased 21% in just three years (2002-2005), and the population in the southern half of the Southern recovery unit declined 68% in seven years (1995-2001). The recent 64% decline in the Maine population, from 66 pairs in 2002 to 24 pairs in 2008, following only a few years of decreased productivity, provides another example of the continuing risk of rapid and precipitous reversals in population growth.

Productivity

Atlantic Coast piping plover productivity is reported as number of chicks fledged per breeding pair. For purposes of measuring productivity, chicks are counted as fledged if they survived to 25 days of age or were seen flying, whichever occurred first. We calculate productivity by dividing the number of fledged chicks by the number of pairs that were monitored and for which number of fledglings could be determined. This includes both successful pairs and pairs that fledged no chicks because they failed to nest or because no eggs hatched or no chicks survived to fledging. Accurate assessment of productivity is facilitated by repeated visits to nesting beaches to monitor individual nests and broods during May, June, July and, if necessary, August.

Annual productivity estimates, 1987-2008, are provided by recovery unit and state in Table 2. The proportion of the population included in annual estimates of productivity (chicks fledged per pair) has continued to improve since 1996, exceeding 90% of breeding pairs coastwide as well as in the New England and Southern recovery units, every year starting in 1998. More than 90% of New York-New Jersey recovery unit pairs were included in productivity estimates in eight of the 11 years from

1998-2008. The percentage of Eastern Canada recovery unit pairs for which productivity estimates were reported in 1998-2008 ranged from 80% to 94%.

Hecht and Melvin (2009) evaluated latitudinal trends in Atlantic Coast piping plover productivity and relationships between productivity and population growth. Overall productivity for the Atlantic Coast population 1989-2006 was 1.35 chicks fledged per pair (annual range = 1.16-1.54), and overall productivity within recovery units decreased with decreasing latitude: Eastern Canada = 1.61, New England = 1.44, New York-New Jersey = 1.18, and Southern = 1.19 (Hecht and Melvin 2009). Within recovery units, annual productivity was variable and showed no sustained trends. There were significant, positive relationships between productivity and population growth in the subsequent year for each of the three U.S. recovery units, but not for Eastern Canada. Regression analysis indicated a latitudinal trend in predictions of annual productivity needed to support stationary populations within recovery units, increasing from 0.93 chicks fledged per pair in the Southern unit to 1.44 in Eastern Canada. Relatively small coefficients of determination (r^2 = 0.09-0.59) for the relationships between annual productivity and population increases in the subsequent year indicate that other factors, most likely annual survival rates of both adults and fledged chicks, also had important influences on population growth rates.

The estimate of productivity needed to maintain a stationary population within New England, 1.21 chicks fledged per pair, based on regression analysis (Hecht and Melvin 2009), is similar to the value of 1.24 that was estimated through population modeling based on survival estimates derived from 1985-1988 banding studies in Massachusetts (Melvin and Gibbs 1996). Regression analysis estimated productivity of 1.44 chicks fledged per pair needed to maintain a stationary population in eastern Canada (Hecht and Melvin 2009), while Calvert et al. (2006) estimated 1.63 chicks per pair for eastern Canada exclusive of southern Nova Scotia, based on estimates of survival derived from 1998-2004 banding studies.

References Cited

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Table 1. Estimated abundance of breeding pairs of Atlantic Coast piping plovers, 1986–2008

State/RECOVERY UNIT	Pairs																						
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Maine	15	12	20	16	17	18	24	32	35	40	60	47	60	56	50	55	66	61	55	49	40	35	24
New Hampshire												5	5	6	6	7	7	7	4	3	3	3	3
Massachusetts	139	126	134	137	140	160	213	289	352	441	454	483	495	501	496	495	538	511	488	467	482	558	566
Rhode Island	10	17	19	19	28	26	20	31	32	40	50	51	46	39	49	52	58	71	70	69	72	73	77
Connecticut	20	24	27	34	43	36	40	24	30	31	26	26	21	22	22	32	31	37	40	34	37	36	41
NEW ENGLAND	184	179	200	206	228	240	297	376	449	552	590	612	627	624	623	641	700	687	657	622	634	705	711
New York	106	135	172	191	197	191	187	193	209	249	256	256	245	243	289	309	369	386	384	374	422	457	443
New Jersey	102	93	105	128	126	126	134	127	124	132	127	115	93	107	112	122	138	144	135	111	116	129	111
NY-NJ	208	228	277	319	323	317	321	320	333	381	383	371	338	350	401	431	507	530	519	485	538	586	554
Delaware	8	7	3	3	6	5	2	2	4	5	6	4	6	4	3	6	6	6	7	8	9	9	10
Maryland	17	23	25	20	14	17	24	19	32	44	61	60	56	58	60	60	60	59	66	63	64	64	49
Virginia	100	100	103	121	125	131	97	106	96	118	87	88	95	89	96	119	120	114	152	192	202	199	208
North Carolina	30	30	40	55	55	40	49	53	54	50	35	52	46	31	24	23	23	24	20	37	46	61	64
South Carolina	3		0		1	1		1			0					0						0	
SOUTHERN	158	160	171	199	201	194	172	181	186	217	189	204	203	182	183	208	209	203	245	300	321	333	331
U.S. TOTAL	550	567	648	724	752	751	790	877	968	1150	1162	1187	1168	1156	1207	1280	1416	1420	1421	1407	1493	1624	1596
EASTERN CANADA*	240	223	238	233	230	252	223	223	194	200	202	199	211	236	230	250	274	256	237	217	256	266	253
ATLANTIC COAST TOTAL	790	790	886	957	982	1003	1013	1100	1162	1350	1364	1386	1379	1392	1437	1530	1690	1676	1658	1624	1749	1890	1849

* includes minor revisions to 1990-2002 Eastern Canada estimates made by CWS in 2005; includes 1-5 pairs on the French Islands of St. Pierre and Miquelon, reported by CWS

Table 2. Estimated productivity of Atlantic Coast piping plovers, 1987–2008

State/RECOVERY UNIT	Chicks fledged/pair																					
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Maine	1.75	0.75	2.38	1.53	2.50	2.00	2.38	2.00	2.38	1.63	1.98	1.47	1.63	1.60	1.98	1.39	1.28	1.45	0.55	1.35	1.06	1.75
New Hampshire											0.60	2.40	2.67	2.33	2.14	0.14	1.00	1.00	0.00	0.67	0.33	2.00
Massachusetts	1.10	1.29	1.59	1.38	1.72	2.03	1.92	1.81	1.62	1.35	1.33	1.50	1.60	1.09	1.49	1.14	1.26	1.38	1.14	1.33	1.25	1.41
Rhode Island	1.12	1.58	1.47	0.88	0.77	1.55	1.80	2.00	1.68	1.56	1.34	1.13	1.79	1.20	1.50	1.95	1.03	1.50	1.43	1.03	1.48	1.68
Connecticut	1.29	1.70	1.79	1.63	1.39	1.45	0.38	1.47	1.35	1.31	1.69	1.05	1.45	1.86	1.22	1.87	1.30	1.35	1.62	2.14	1.92	2.49
NEW ENGLAND	1.19	1.32	1.68	1.38	1.62	1.91	1.85	1.81	1.67	1.40	1.39	1.46	1.62	1.18	1.53	1.26	1.24	1.40	1.15	1.34	1.30	1.51
New York	0.90	1.24	1.02	0.80	1.09	0.98	1.24	1.34	0.97	1.14	1.36	1.09	1.35	1.11	1.27	1.62	1.15	1.46	1.44	1.55	1.15	1.21
New Jersey	0.85	0.94	1.12	0.93	0.98	1.07	0.93	1.16	0.98	1.00	0.39	1.09	1.34	1.40	1.29	1.17	0.92	0.61	0.77	0.84	0.67	0.64
NY-NJ	0.86	1.03	1.08	0.88	1.04	1.02	1.08	1.25	0.97	1.07	1.02	1.09	1.35	1.19	1.28	1.49	1.07	1.23	1.28	1.36	1.03	1.10
Delaware		0.00	2.33	2.00	1.60	1.00	0.50	2.50	2.00	0.50	1.00	0.83	1.50	1.67	1.50	1.17	2.33	1.14	1.50	1.44	1.33	0.30
Maryland	1.17	0.52	0.90	0.79	0.41	1.00	1.79	2.41	1.73	1.49	1.02	1.30	1.09	0.80	0.92	1.85	1.56	1.86	1.25	1.06	0.78	0.41
Virginia		1.02	1.16	0.65	0.88	0.59	1.45	1.66	1.00	1.54	0.71	1.01	1.21	1.42	1.52	1.19	1.90	2.23	1.52	1.19	1.16	0.87
North Carolina			0.59	0.43	0.07	0.41	0.74	0.36	0.45	0.86	0.23	0.61	0.48	0.54	0.50	0.17	0.46	0.65	0.92	0.87	0.26	0.30
SOUTHERN	1.17	0.85	0.88	0.72	0.68	0.62	1.18	1.37	1.05	1.34	0.68	0.99	1.04	1.09	1.22	1.27	1.63	1.95	1.38	1.12	0.92	0.67
U.S. average	1.04	1.11	1.28	1.06	1.22	1.35	1.47	1.56	1.35	1.30	1.16	1.27	1.45	1.17	1.40	1.34	1.24	1.43	1.24	1.30	1.13	1.19
EASTERN CANADA		1.65	1.58	1.62	1.07	1.55	0.69	1.25	1.69	1.72	2.10	1.84	1.74	1.47	1.77	1.18	1.62	1.93	1.82	1.82	1.14	1.47